

WHFS - WFO HYDROLOGIC FORECAST SYSTEM

REVISION 2.2

OPERATIONAL USER'S GUIDE AND TRAINING MANUAL

HYDROLOGIC DATA VIEWING SYSTEM RIVER PRODUCT FORMATTER HYDROLOGIC DATABASE

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A list of HydroView, RiverPro and HydroBase windows and their associated page numbers is provided at the beginning of Chapters 3, 4 and 5, respectively.

1. What is the WHFS?

Introduction

The Weather Forecast Office (WFO) Hydrologic Forecast System (WHFS) is an integrated system of hydrologic software which is used by Service Hydrologists and hydrology focal points in the management of WFO hydrology programs and provides a tool for all WFO operational staff (as opposed to just hydrologists) to use in the conduct of hydrologic operations for the WFO Hydrologic Service Area (HSA) such as issuance of products for flash floods and main-stem river flood episodes.

The software works in conjunction with observed hydrometeorological data and the River Forecast Center (RFC) guidance and was designed for ease of use with the meteorologist in mind. The various components of the WHFS allow the forecaster to monitor hydrologic conditions and events, manage hydrologic and meteorological data, and then generate public products when appropriate. The WHFS automates the generation and issuance of river statements, flood warnings, and flood statements for locations within the WFO HSA.

Many WHFS software system components can be accessed through an interactive graphical user interface (GUI). The GUI enhances the usefulness of the WHFS as a tool for the forecaster because of its ease of use in viewing and editing data and information.

The WHFS was developed and is supported by the National Weather Service (NWS) Office of Hydrology. The system is designed to easily allow for future revisions as software capabilities are developed or improved. The WHFS was developed under C/X-Windows/Motif standards and interacts with an Informix relational database of hydrologic-oriented information (the Integrated Hydrologic Forecast System data base, IHFS_DB, Version 1.2). The WHFS will be integrated with other Advanced Weather Interactive Processing System (AWIPS) components in the future. These other AWIPS components include the WFO-Advanced package which is used to display graphical information such as atmospheric model outputs, satellite imagery, and radar information and the Interactive Forecast Preparation System (IFPS) which is used to produce forecaster-modified fields of graphical information such as temperature and quantitative precipitation forecasts. The WHFS, WFO-Advanced and IFPS execute on the same AWIPS platform. Future AWIPS upgrades will incorporate these components in a more integrated database and graphical user interface environment that may, for example, alarm a forecaster viewing a meteorological graphic that a River Forecast Center (RFC) guidance product (e.g., flash flood guidance or FFG) has been received.

WHFS Components

The **Hydrologic Database Manager (HydroBase)**, **Hydrologic Data Viewing System (HydroView)** and **River Product Formatter (RiverPro)** form a suite of WHFS applications used for hydrologic monitoring, public product generation and data management. Both HydroView and RiverPro extract data resident in the IHFS to perform various operational functions.

The core WHFS components are graphically displayed in Figure 1.

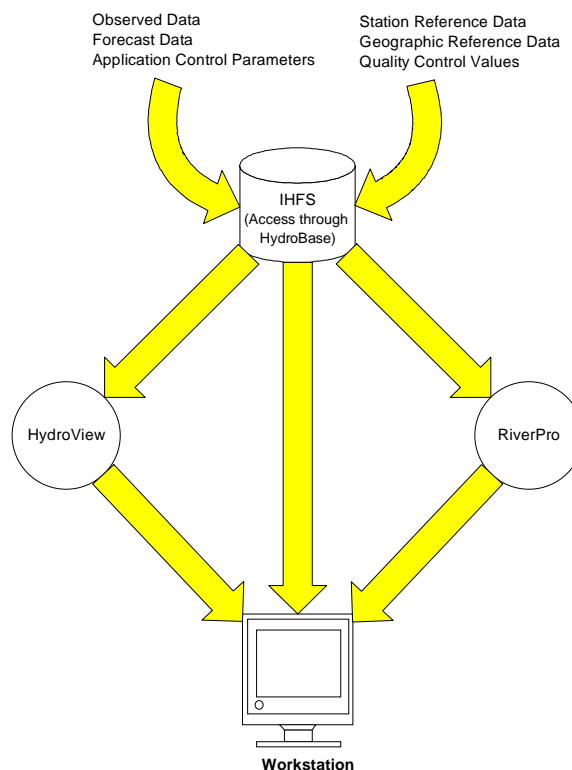


Figure 1. WHFS Core Components

An overview of each component is provided below.

HydroView is the key operational component of the WHFS for the meteorological forecaster. The forecaster can use HydroView to monitor hydrologic situations and events and display hydrologic and meteorological data in tabular and time series formats. (A time series is a one-dimensional array of observed data or computed values for a period of time, such as a sequence of 6-hourly river stage readings.) HydroView provides a geographic view of the Hydrologic Service Area with various hydrometeorological data collection stations and forecast points which are color coded based on their flood status (i.e., as an action stage or flood stage). Collection station data can be displayed as an icon only or as both the station icon and the user-selected data element value.

Precipitation data can be displayed for various durations up to 72 hours and for a specified ending time. HydroView also permits the forecaster to overlay areal and gridded data displays. Areal displays for basins, counties and zones include Mean Areal Precipitation (MAP) and Flash Flood Guidance (FFG). Stage II (gage-only and radar/gage grids) computed hourly precipitation accumulation gridded displays can be overlaid as a further aid in monitoring hydrologic events. The forecaster can also display comparisons of observed precipitation and flash flood guidance in order to better assess flash flood threats. Using HydroView, the forecaster can access detailed information regarding dams and reservoirs within the HSA, including pre-calculated forecasts of flow, stage and transit times for a dam break scenario.

RiverPro automates the generation and issuance of River Statements, Flood Statements and Flood Warnings for locations within the WFO Hydrologic Service Area. RiverPro extracts observed and forecast river stages from the hydrologic data base and compares these data to threshold stage values that represent flood categories. Based on this analysis of current or forecast hydrologic conditions and, when applicable, the history of recently issued products, RiverPro determines a recommended product (e.g., Flood Warning) applicable to recommended locations within the Hydrologic Service Area. The forecaster then has the option to accept the RiverPro-generated recommendation and to use predefined templates that specify the product format and content or to edit and specify which product (statement or warning) to issue and which locations to include in the product. Based on customized instructions, RiverPro will issue the product once all review and edits are complete. RiverPro also displays various data and information to assist the forecaster in determining which products are appropriate to issue.

HydroBase manages the static information for the hydrometeorological data collection stations and forecast points located throughout the Hydrologic Service Area. HydroBase is interactive which allows for adding, editing, and displaying the static data and information that are used by both HydroView and RiverPro. HydroBase also produces various reports such as a graphical flood report, WS Form E-19 Report, WS Form B-44 Report, a station list report, and a station classification report. Reports can be viewed, printed or e-mailed from the HydroBase application.

The forecaster will primarily use HydroView and RiverPro in performing WFO hydrologic operations. HydroBase screens will be used by the forecaster for informational purposes only. The static data and information accessed in HydroBase that are used by the forecaster in monitoring a hydrologic event are also displayable through HydroView. Maintaining HydroBase is the function of the Service Hydrologist. The forecaster should interact with the Service Hydrologist regarding the HydroBase database. Access to HydroBase can be controlled through use of the optional password function. The password is set in HydroBase.

Purpose of this Manual

This manual has been designed to be both a training guide and user's manual for the operations of the WHFS. It is meant to aid the forecaster and Service Hydrologist in using the WHFS to perform the hydrologic operations of the WFO. Information in the manual is presented from an operational point-of-view and focuses on the user interface. Therefore, WHFS displays and applications which are key in performing hydrologic operations have the primary focus.

Located throughout the manual are user-friendly tips and notes regarding the use of the various functions and operations in the WHFS. These should prove useful when operating the system.

For additional information regarding basic hydrology, hydrologic data and information, WFO hydrologic operations, and WFO/RFC responsibilities refer to *Correspondence Course - Operations of the NWS Hydrologic Services Program, March 1997 (and corresponding updates)*.

2. Overview of the WHFS

The following sections provide an overview of the functions of the WHFS components. The operational uses for each component are discussed in more detail in subsequent sections of this manual.

HydroView

The Hydrologic Data Viewing System (HydroView) is an interactive application that enables the forecaster to monitor dynamic, hydrologic events. The primary function of HydroView is to display reference collection station information and observed and/or forecast hydrometeorological data. HydroView also facilitates the editing of certain realtime data and information although some data can only be edited in HydroBase. The data which are monitored in HydroView are managed by HydroBase and used by RiverPro. HydroView is designed to display data and information for specific points as well as gridded data for specific areas within the Hydrologic Service Area (HSA).

HydroView is more than a data display tool. Its user-friendly displays are intended for operational use. The data and information graphical displays are useful analytical tools for timely monitoring of events and for verifying the accuracy of products prior to their dissemination to the public.

Key features of HydroView include the following.

For Specific Data Points

- ! Displays locations of river forecast points, river data points, and reservoir stations on a geographic display with color coding indicating flood status;
- ! Displays locations of other hydrometeorological data collection stations (e.g., precipitation, temperature) and cooperative observers on the geographic display;
- ! Displays station identifiers and observed and forecast data values (e.g., precipitation totals, river stage) for forecast points and other collection stations, and;
- ! Plots time series of various types of hydrologic and meteorological data, including river stage and precipitation.

For the Geographic Area

- ! Displays WHFS-calculated Mean Areal Precipitation (MAP) by basins, counties, and zones for durations of one to twenty-four hours;
- ! Displays Flash Flood Guidance (FFG) as issued by the appropriate River Forecast Center by basins, counties, and zones;
- ! Displays comparisons (as an arithmetic difference or as a percentage) of observed precipitation and FFG on a geographic display or in tabular form for flash flood threat evaluations;
- ! Displays gridded precipitation totals based on Doppler radar estimates only, gage only, and radar plus gage measurements, and;
- ! Allows the forecaster to modify thresholds and color for areal displays such as radar, FFG and MAP.

Mean Areal Precipitation (MAP) displays are calculated in WHFS based on the Stage II precipitation processing gage-only grid and on the Stage II gage-radar (multi-sensor) grid. The MAP displays may not correspond to those issued by the RFC since the RFC may use different methods to calculate MAPs.

Other Information and Capabilities

- ! Displays various geographic map backgrounds such as streams and lakes, basins, counties, cities, and radar locations and umbrellas;
- ! Displays observer/contact information, including telephone numbers;
- ! Allows editing and managing of some observed data;
- ! Allows the forecaster to select specific precipitation estimates and FFG settings (times and durations) to be displayed;
- ! Displays products (e.g., river statements, data reports, flood warnings);

- ! Displays data and information regarding dams in the area of responsibility including pre-calculated forecasts of flow, stage and travel time for a dam break, and;
- ! Provides various informative displays such as station geophysical information, station reporting status, station precipitation and stage forecasts, data quality control status, crest history and rating curves.

All activities through HydroView begin with the Root Window screen. (In an X Window environment, the *Client* is an application program which interacts with the X Server program to make requests concerning the display details in a particular window.) The HydroView Root Window, which is shown in Figure 2, provides the base from which all HydroView capabilities can be exercised.

The HydroView client is the most important client in the WHFS application. Most of the WHFS operational functions are exercised through the HydroView Root Window.

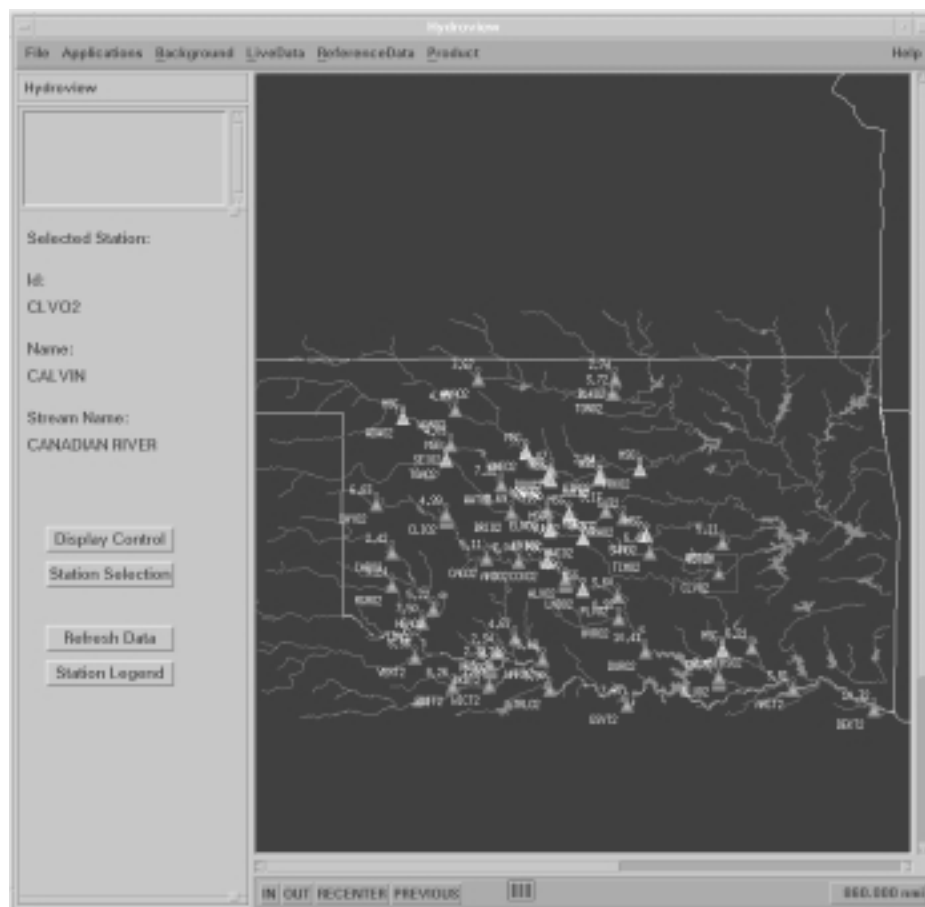


Figure 2. HydroView Root Window

The HydroView root window contains the following features.

- ! A **Tool Box** along the left side of the window with menu buttons;
- ! A large **Geographic Display** area to the right of the tool box;
- ! **Map ToolSet** buttons along the bottom of the geographic display area, and;
- ! A **Menu Bar** across the top of the window displaying HydroView menu options.

From the HydroView Root Window, the following can be accomplished.

From the Tool Box

- ! View the name of the currently selected station;
- ! Select **Display Control** to filter the information shown on the geographic display, for example;
 - Point Data
 - # Data stations, sources, and identifiers
 - # River stage, precipitation, snow, temperature, other variables
 - # Forecast and/or observed values
 - # Time periods (precipitation accumulation only)
 - Areal Data (color coded)
 - # Mean areal precipitation
 - # Flash flood guidance (from the RFC)
 - # Gridded precipitation values (based on radar and/or gage data)
 - # Precipitation/FFG comparison;
- ! Select **Station Selection** for the current station;
- ! Select **Refresh Data** to update data and refresh station icons based on last 15-min. data, and;
- ! Select **Station Legend** to interpret icon displays.

From the Geographic Display

- ! View the point and areal data and information discussed above;
- ! View forecast point, data point and reservoir flood status (via color coded icons);
- ! Determine latitude and longitude of a point in the display (using the cursor);
- ! Select the current station for further analyses (single-clicking), and;
- ! Display time series for a selected station (double-clicking).

From the Map ToolSet

- ! Zoom in and zoom out, recenter display, and restore previous display, and;
- ! View the geographic display width.

From the Menu Bar

- ! Select **File**
 - # Terminate client
 - # Exit;
- ! Select **Applications**
 - # Shared Window Server
 - # Areal Viewer
 - # HydroView;
- ! Select **Background** (for geographic display)
 - # Rivers, streams and lakes
 - # Basins, counties and zones
 - # Cities and towns
 - # Highways and roads
 - # Radars (locations and umbrellas);
- ! Select **LiveData** (for selected station)
 - # Graphical time series (for all collected data)
 - # Station observations
 - # Station forecasts
 - # River summaries
 - # Station profile (geographical)
 - # Station reporting status (for all stations)
 - # Out-of-range data
 - # Manually rejected observations;
- ! Select **ReferenceData** (for selected station)
 - # Staff gage
 - # Impact Statement (statements listed by stage)
 - # Rating curve
 - # Data sources (e.g., DCP, observer)
 - # Contacts
 - # Crest history
 - # Dam catalog, and;
- ! Select **Products** (for selected or other stations)
 - # Product Viewer (text products in data base, e.g., gage reports, river statements, flood watches)

RiverPro

The River Product Formatter (RiverPro) is designed to assist the forecaster in disseminating hydrologic information to the public by automatically generating and issuing standardized NWS hydrologic products. The software provides the forecaster with recommended products and recommended forecast points to include in each product. RiverPro gives the forecaster the flexibility to accept and issue the recommended products or to edit the product prior to its issuance.

RiverPro would typically be started after the forecaster has evaluated the hydrologic conditions using HydroView. This evaluation is necessary to ensure that the products issued to the public are of the highest quality. RiverPro is not started automatically but must be initiated by the forecaster based on the observed or forecast hydrologic conditions or WFO reporting requirements.

Key features of RiverPro include the following.

- ! The forecaster can generate and issue the following hydrologic products with RiverPro:
 - # River Statements (RVS),
 - # Flood Warnings (FLW),
 - # Flood Statements and Terminating Flood Statements (FLS);
- ! The forecaster has the option to accept the recommendation from RiverPro or customize the recommendation by specifying which product to issue and which forecast points to include in the statement or warning;
- ! The forecaster has the ability to add text to the FLW and FLS products to further define the basis for the warnings and statements;
- ! The forecaster has the option to edit the content of the product by modifying the message text, and;
- ! RiverPro products are formatted to provide information in a plain language text format as well as pertinent data regarding observed and forecast stages and status compared to past crests and floods.

RiverPro extracts both static and dynamic data from the hydrologic database. Static data include forecast point names and their respective groupings plus information found in WS Form E-19, *Report on River Gage Stations*, (e.g., impact statements and historical crests). Dynamic data include observed and forecast river stage data plus carryover data (not to be confused with carryover data as applied in the context of the NWS River Forecast System) from previously issued RiverPro products for each forecast point. (Carryover information from previous

executions of RiverPro include stage information associated with the previous product in which a specific forecast point was last included and the time and type of the previous product. This carryover data must be saved so that the recommendations for subsequent runs have continuity. The carryover information is compared with current values to help determine the recommended product and which forecast points are to be included.)

RiverPro analyzes forecast and observed data, then determines derived values from stage time series data (e.g., maximum forecast value). Using this derived information, RiverPro automatically determines the recommended product to issue and the recommended forecast points to include. RiverPro creates products based on the following:

- ! WS Form E-19 (*Report on River Gage Stations*) information, carryover information from previous RiverPro products, and current river stage data are read and analyzed to compute various derived values (e.g., maximum forecast stage);
- ! Input data and RiverPro-computed values, which are also used to determine the recommended product to generate and the forecast points to include;
- ! Pre-defined instructions that specify how products are generated (e.g., certain instructions define the appropriate set of text templates to use), and;

RiverPro then generates the product.

RiverPro creates river products that are constructed and formatted properly for the auto-voice NOAA Weather Radio (NWR). Users can set up templates for NWR and non-NWR products.

All activities in RiverPro begin with the Root Window screen. This window, which is shown in Figure 3, provides the base from which all RiverPro capabilities can be exercised.



Figure 3. RiverPro Root Window

The RiverPro Root Window contains the following features.

- ! **Text displays** identifying selectable hydrologic products to be generated;
- ! A **Recommended Product Display** identifying the RiverPro recommended product, and;
- ! A **menu bar** across the top of the window displaying RiverPro menu options.

RiverPro recommendations for hydrologic products are based on current observed data and/or RFC forecast products stored in the database and the past history of products issued for the included river forecast points.

From the RiverPro Root Window, the following can be accomplished.

From the Text Displays

- ! View the products available to be issued, including the recommended hydrologic products and
- ! Select and edit a non-recommended product.

From the Menu Bar

- ! Select **Product**
 - # Create the selected product
 - # Edit the selected product
 - # Issue the selected product
 - # Exit RiverPro;
- ! Select **Settings**
 - # Select forecast groups and points to include in the product and review RiverPro recommended forecast points
 - # Modify product generation settings
 - Product sections/subsections to include
 - Order of product sections
 - Order of forecast point subsections
 - Data usage (defaults, QPF, out-of-range data)
 - Upper/lower case for product text
 - # Reset to recommended (default) product generation settings
 - # Save changes to file, where appropriate;
- ! Select **ForecastPoint**
 - # View stage data for all, recommended (by RiverPro) and included (by the forecaster) forecast points
 - # View recommendation information for all, recommended and included forecast points plus segregated RVS, FLS (terminating), FLS and FLW recommended points
 - # View previous product information for all and included forecast points plus segregated RVS, FLS (terminating), FLS and FLW previous points
 - # View WS Form E-19 information for all and included forecast points, and;
- ! Select **Logs**
 - # View previous product log
 - # View the message log (warnings and errors)
 - # View the error log (warnings and errors)

A sample RiverPro product is shown in Figure 4.

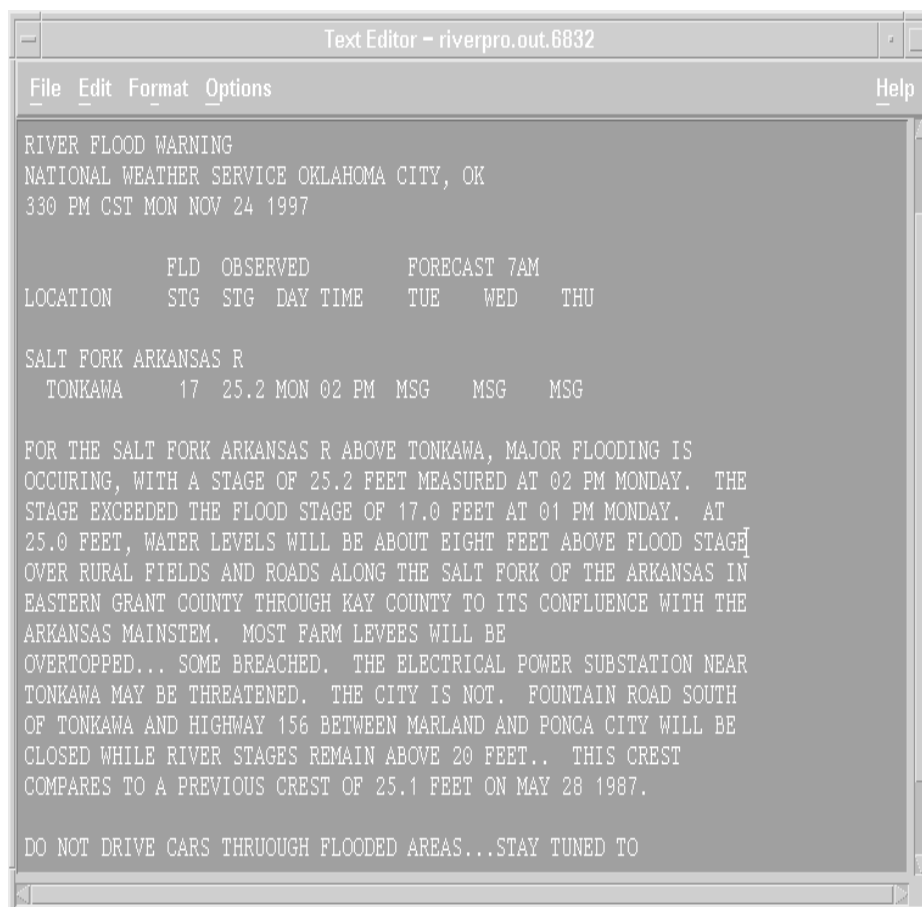


Figure 4. Sample RiverPro Product

While this manual focuses only on the user interface, the functional aspects of RiverPro are detailed in the *RiverPro Reference Manual*.

HydroBase

The Hydrologic Database (HydroBase) is an interactive component of the WHFS which is used to display, edit and add static information about the hydrometeorological data locations, river forecast points and other pertinent information in the hydrometeorological database. The main purpose of HydroBase is to provide an interface to this parametric information which is used by HydroView, RiverPro and other applications. The WHFS is supported by the Informix relational database (Integrated Hydrologic Forecast System data base, IHFS_DB) deployed to both WFOs and RFCs. HydroBase acts as the interface between IHFS_DB and the components of the WHFS.

This manual addresses some of the basic functional uses of HydroBase - the routine display, edit and addition of hydrometeorological data and information. HydroBase can also be used operationally to update static data and information as needed (e.g., update flood history information when a record has been exceeded during an event), although normally only the Service Hydrologist will perform this function. HydroBase must be completely set up and all information be checked for accuracy prior to using HydroView or RiverPro. During normal operations, HydroBase operations will be transparent to the WHFS user.

Maintenance of the static information in the IHFS database is generally the responsibility of the Service Hydrologist or designee. Access to the database should be limited within the WFO through use of the **optional password function** in order to ensure its integrity. The password is set in HydroBase. More information on the password function is provided in Chapter 5 of this manual.

For additional information on hydrologic parametric information see the most current version of the *Service Hydrologist Information Management System (SHIMS) Handbook*.

The key feature of HydroBase is the capability to display and edit the following types of static data and information used by HydroView and RiverPro.

- ! Hydrometeorological Data Locations and River Forecast Points
 - # Station location (e.g., contacts, county, data sources);
 - # River gage (e.g., flood information, impact statement, rating curve, datum, history),
 - # Dam information and data including pre-calculated forecasts of flow, stage and travel time for a dam break and;
 - # Reservoir (e.g., type, elevations, pools, uses).

! Reference Data Information

- # Cities (e.g., coordinates, population);
- # States/counties/zones;
- # Forecast groups;
- # Radar locations;
- # Stage II parameters;
- # Areal and vector definitions, and;
- # NOAA Weather Radio transmitter towers.

HydroBase allows for the editing and managing of some RiverPro parameters such as the number of look back hours for observed data, look ahead hours for forecast data and the default number of hours before product expiration. In addition, HydroBase can be used to define forecast groups and to order the groups and forecast points for tailoring the RiverPro display and generated products. HydroBase can also be used to select the primary stage parameter for RiverPro to use for each forecast point.

HydroBase can be used to review and edit the incoming data ingest filters, quality control checks and data purge parameters.

HydroBase provides the capability to print, e-mail, or save to a file the following reports:

- ! Flood history reports for river gages and reservoirs (display only, no editing permitted);
- ! WS Form E-19 and WS Form E-19A (*Report on River Gage Station*), and;
- ! WS Form B-44 (*Unofficial Cooperative Station Report*).

All the information on dams in the Dam Catalog can be viewed as well as edited in HydroBase (this information can only be viewed in HydroView). The static data in Dam Catalog is derived directly from the 1993-1994 *National Inventory of Dams* distributed by the U.S. Corps of Engineers. The dam break scenario data in Dam Catalog was computed by the Hydrologic Research Laboratory using a simplified dam break model for only one scenario for one point downstream of the dam. The WHFS database has been configured to allow multiple dam break scenarios for multiple downstream points should that information be available. Using the Reservoir and Dam Catalog dialogs in HydroBase, reservoirs can be associated with specific dams for reference.

All activities in HydroBase begin with the Root Window screen. This window, which is shown in Figure 5, provides the base from which all HydroBase capabilities can be exercised.



Figure 5. HydroBase Root Window

The HydroBase Root Window contains the following features.

- ! A **text display** listing all data stations in the HSA (hydrometeorological, river gage and reservoirs) and their associated county, basin, stream, or latitude and longitude;
- ! A **menu bar** across the top of the window displaying the HydroBase menu options;
- ! A **quick reference tool bar** (optional) to allow faster access to key information and data sets, and;
- ! **Sort and search utilities** at the bottom of the window for use with the text display.

The Menu Bar and the Quick Reference Tool Bar are used to access screens to input new or modify existing data and information in HydroBase.

From the HydroBase Root Window, the following can be accomplished.

From the Text Display

- ! View all hydrometeorological data stations, river gage stations and reservoirs in the HSA, and
- ! View station information (identifier, county, basin, stream, lat/lon)

From the Quick Reference Tool Bar

- ! Click to obtain access to the following for the selected station:
 - # Location information
 - # Contact(s) information
 - # River gage information (if applicable)
 - # Flood categories
 - # Impact statements
 - # Reservoir information (if applicable)

From the Sort and Search Utilities

- ! Sort the Text Display by station, name or county, and;
- ! Perform a quick search using the station identifier rather than scrolling for a station.

From the Menu Bar

- ! **Select File**
 - # Preferences (for Text Display);
 - # Add or remove Quick Reference Tool Bar, and;
 - # Exit HydroBase.
- ! **Select Location**
 - # Add location;
 - # Modify location (for a selected station);
 - # Contacts (for a selected station);
 - # County and zone selection (for a selected station), and;
 - # Data sources (DCP, observer, telemetry).
- ! **Select RiverGage** (for a selected river gage station)
 - # River gage (geophysical and additional information);
 - # Flood category (define categories - major, moderate, minor);
 - # Impact statement (organized by stage);
 - # Flood damage (expected damage organized by stage);
 - # Rating curve;
 - # Crest history (maximum flows);
 - # Low water (minimum flows);
 - # Benchmark (where applicable);
 - # Datum (elevation of gage zero);
 - # Description;
 - # Gage history;
 - # Publications, and;
 - # References.
- ! **Select Reservoir** (for a selected reservoir station) - Information, elevations, pools, association with a dam in Dam Catalog
- ! **Select Dam Catalog** - General, physical, agency, reservoir and dam break information
- ! **Select Data Ingest**
 - # Ingest filter (set incoming data filter parameters);
 - # Range check (set quality control parameters), and;
 - # Purge parameters (set data and product purge parameters).
- ! **Select Reports** (for a selected station)
 - # Flood report (specific flood event time series), and
 - # Text reports (E-19s, B-44A, station list, station class)
- ! **Select Setup** (for HSA-specific information)
 - # Administration;
 - # Cities;
 - # States/counties/zones;
 - # Reference fields ;
 - # RiverPro general parameters;
 - # RiverPro Forecast Groups/Points
 - # Radar locations;
 - # Stage II parameters;
 - # Areal definitions (zones, counties, basins, reservoirs), and;
 - # Vector definitions (rivers, streams, highways, roads for geographical display)
 - # NWR transmitter towers

Stage II Processing

Stage II precipitation processing is accomplished within the WHFS in order to compute precipitation grids for the radar umbrella. Mean Areal Precipitation (MAP) values are computed using the gridded precipitation data from Stage II and, knowing the geographic extent of the areas, the average precipitation for each area is computed. Displays of these data are provided through HydroView (Display Control Window). HydroView permits the forecaster to display the Stage I radar grid (without any precipitation-gage bias adjustments at this time), the Stage II hourly precipitation-gage only grid, the Stage II hourly combined precipitation-gage and radar data grid, and the MAP grids. The Stage II-computed hourly precipitation accumulation is based on a precipitation-gage only grid and a multi-sensor grid which combines precipitation-gage data and radar data. Input radar data are from the Stage I processor within the WSR-88D. The Stage II radar and precipitation gage combination processing is performed based on application control parameters which can be accessed through HydroBase.

A Stage II User's Guide is provided in Appendix A of this document.